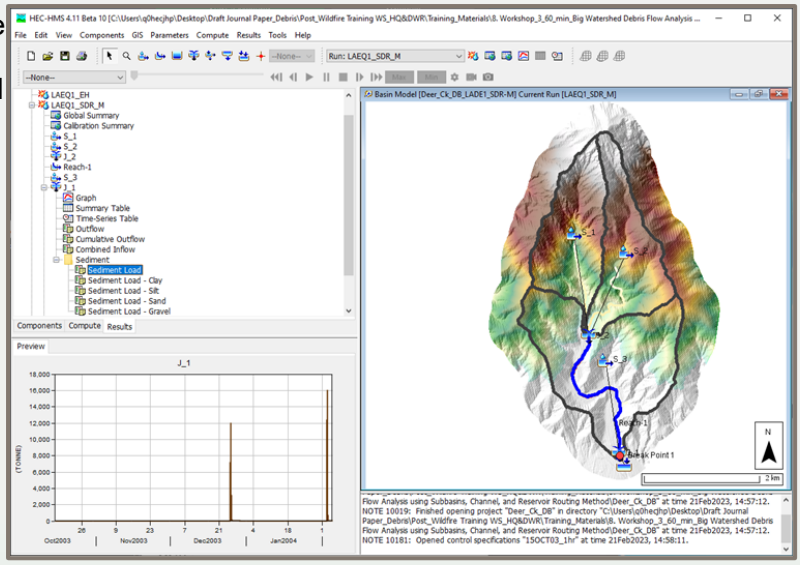
U.S. Army Corps of Engineers (USACE)
BUILDING STRONG®

Hydrologic Engineering Center (CEIWR-HEC)
Hydrologic Modeling System (HEC-HMS)

Description



Post-wildfire hydrology and debris flow prediction are essential in comprehending the risks posed by debris and determining the optimal management and maintenance strategies for debris basins. Accurate prediction in this regard directly impacts downstream communities by influencing emergency response, flood control, debris flow control, and water quality and supply management. There could be a heightened risk of debris flows and increased flooding in areas affected by wildfires when high-intensity precipitation falls onto a burned watershed. To address these challenges, the Hydrologic Modeling System (HEC-HMS) offers robust post-wildfire hydrology and debris flow modeling features, which provide valuable insights into the expected rise in peak flows and debris yields originating from burned watersheds.
The figure illustrates the post-wildfire debris flow model for the Deer Creek debris basin following the Padua Fire, Grand Prix Fire, and Old Fire in the San Gabriel Mountains and San Bernardino Mountains in October and November 2003.

Benefits

The HEC-HMS Post-Wildfire Hydrology and Debris Flow capabilities offers several key benefits:
1. Enhanced Understanding of Post-Fire Hydrologic Response Phenomenon: The module improves our understanding of both single event or long-term (series of events) post-fire hydrological processes. Within HEC-HMS, a comprehensive analysis can be performed on the impacts of wildfires and the dynamics driving the precipitation-runoff response.
2. Accurate Prediction of Stream Flow, Depth, and Debris Flows: HEC-HMS facilitates improved prediction of post-fire stream flow, depth, and debris flows. The module offers both empirically lumped and physically distributed methods, providing flexibility in selecting the appropriate approach for different scenarios and levels of detail.
3. Effective Screening of Post-Fire Flood Risk: HEC-HMS enables improved screening-level prediction of post-fire flood risk, allowing for better emergency response and management. By simulating the potential flood hazards after a wildfire, the software assists in assessing the vulnerability of downstream areas and aids in proactive decision-making.
4. Long-Term Modeling for Holistic Analysis: HEC-HMS includes a continuous modeling framework that spans weeks to decades (the only limitation is the amount of meteorologic data available to drive the model). This extended timeframe enables the simulation of post-fire flooding, debris flow risk, and ecological recovery in downstream ecosystems and communities. By considering long-term effects, modelers can develop more effective strategies for mitigating and managing post-fire impacts.
5. Comprehensive Representation of Burned and Unburned Watersheds: The module uniquely places equal value on both burned and unburned natural watersheds. This comprehensive approach ensures a holistic understanding of the post-wildfire hydrology and debris flow processes, allowing for a more accurate assessment of the overall watershed response.

POC: jay.h.pak@usace.army.mil

U.S. Army Corps of Engineers - CEIWR-HEC
Hydrologic Engineering Center, Institute for Water Resources
609 Second Street
Davis, CA 95616-4687
http:/www.hec.usace.army.mil; Webmaster-HEC@usace.army.mil

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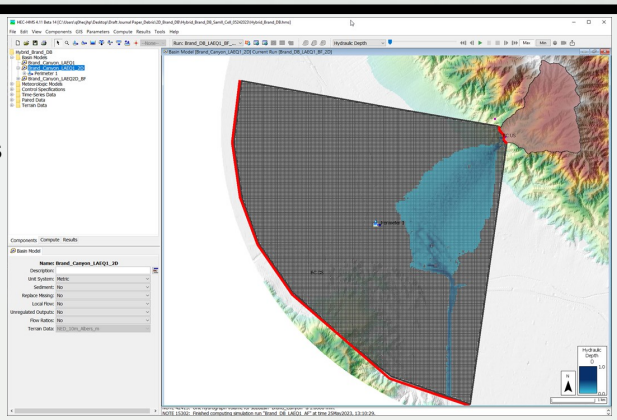
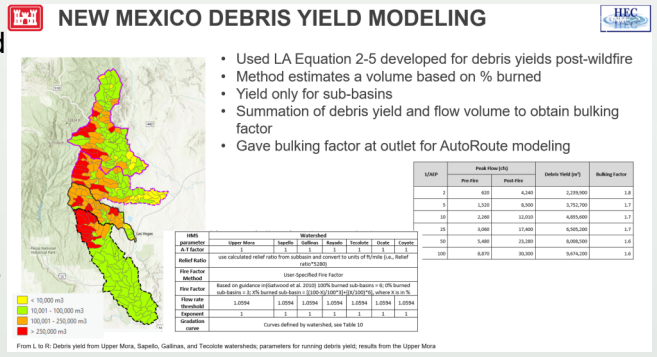
By leveraging the Post-Wildfire Hydrology and Debris Flow capabilities in HEC-HMS, users can gain valuable insights into the complex dynamics of post-fire environments. This empowers decision-makers, emergency response teams, and land managers to implement appropriate measures to mitigate risks, protect ecosystems, and enhance community resilience. The figure illustrates the debris flow inundation mapping capability with the HEC-HMS hybrid model including 2D Diffusion Wave Transform.



Applications

1.Post-Wildfire Debris Flow Risk and Emergency Management: HEC-HMS is extensively employed by the post-wildfire hydrologic modeling community to develop effective strategies for assessing and managing debris flow risks in post-fire environments. The software's advanced modeling features enable a comprehensive understanding of the anticipated increase in peak flows and debris yields from burned watersheds, facilitating the formulation of robust emergency management plans.

2.Estimation of Debris Flow and Sediment Load: HEC-HMS offers enhanced capabilities for estimating both the background and anthropogenic debris flow and hyper-concentrated sediment loads. This functionality is particularly valuable for conducting specialized debris flow analyses tailored to burned watersheds. HEC-HMS focuses on simulating post-wildfire hydrology and debris flow dynamics in streams, rivers, and lakes, allowing for accurate modeling of runoff and debris movement through the watershed and reservoirs/debris basins.



3.Multi-Disciplinary Utility for Diverse Stakeholders: HEC-HMS exhibits broad applicability across various sectors. It serves as a valuable tool for state and local governments engaged in local or regional planning activities. Private architectural and engineering firms leverage the software to facilitate design work associated with hydrological systems. Furthermore, HEC-HMS serves as an educational resource for university professors, aiding in the teaching of hydrologic modeling and analysis concepts.

Key Features

HEC-HMS includes a number of hydrology features as well as advanced simulation and analysis features:

- Precipitation
- Plant Evapotranspiration
- Snowmelt
- Ground Surface Storage
- Soil Infiltration
- Surface Runoff
- Subsurface Baseflow
- Channel Routing with Losses
- Diversion Structures
- Reservoirs with Operation
- Interior Flood Hydrology
- Storm Events
- Continuous Simulation
- Gridded Models
- Physically-Based Models
- Automatic Parameter Estimation
- Flow Forecasting
- Depth-Area Analysis
- Monte Carlo Uncertainty
- Erosion and Sediment
- Probable Maximum Precipitation
- Ensembles
- **Post-Wildfire Hydrology**
- **Debris/Hyper Concentration Yield/Flow**
- **Dynamic Reservoir Sediment Volume Reduction**

Technology Transfer

Technology transfer material is available from: https://www.hec.usace.army.mil/confluence/hmsdocs/.

- Manuals describing the User Interface, computational methods, applications, and software validation
- Tutorials and Guides with step-by-step instruction and example projects illustrating software application
- Class training material with slides, videos, and hands-on workshops
- Webinars highlighting software capabilities